Abstract of the Disclosure

Flow rate measurement system includes two measurement regions 14,16 located an average axial distance ΔX apart along the pipe 12, the first measurement region 14 having two unsteady pressure sensors 18,20, located a distance X_1 apart, and the second measurement region 16, having two other unsteady pressure sensors 22,24, located a distance X_2 apart, each capable of measuring the unsteady pressure in the pipe 12. Signals from each pair of pressure sensors 18,20 and 22,24 are differenced by summers 44,54, respectively, to form spatial wavelength filters 33,35, respectively. Each spatial filter 33,35 filters out acoustic pressure disturbances $P_{acoustic}$ and other long wavelength pressure disturbances in the pipe 12 and passes short-wavelength low-frequency vortical pressure disturbances $P_{vortical}$ associated with the vortical flow field 15. The spatial filters 33,35 provide signals P_{as1},P_{as2} to band pass filters 46,56 that filter out high frequency signals. The $P_{vortical}$ -dominated filtered signals P_{asf1},P_{asf2} from the two regions 14,16 are cross-correlated by Cross-Correlation Logic 50 to determine a time delay τ between the two sensing locations 14,16 which is divided into the distance ΔX to obtain a convection velocity $U_c(t)$ that is related to an average flow rate of the fluid (i.e., one or more liquids and/or gases) flowing in the pipe 12. The invention may also be configured to detect the velocity of any desired inhomogeneous pressure field in the flow. The invention may also be combined with an instrument, an opto-electronic converter and a controller in an industrial process control system.